



United States
Department of
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Forest
Service

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Subject: Status of Forest Pest Management Ozone Injury Plots on the Kings
River Ranger District (FPM Report No. C95-4)

To: Ray Porter, Kings River RD
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While attending an ID Team meeting for the Kings River Administrative Study in March, 1995, I mentioned that Forest Pest Management (FPM) has been following the trend in ozone injury to pines on the Sierra National Forest since 1977. Below is data that has been collected at 5 sites on the Kings River District. Because of bias associated with the study's survey design, these results should not be used to make statements about the amount of air pollution injury occurring over the entire District. It is, however, acceptable to compare the injury ratings over time for individual plots and generalize about the changes or trends in ozone injury.

There are 27 ozone trend plots on the Sierra National Forest, and each is located where a road or trail intersects a 1000' contour interval between 4000 and 8000 feet elevation. All plots consist of 10 ponderosa or Jeffrey pines that occur in an area of 1.2 acres or less. Plot trees are no less than 33 feet from the road edge and have been numbered with tree paint at DBH on the side of the trees facing away from the road. A small orange paint spot is usually present on a roadside tree to mark the location of plots. A forest map with plot locations will be provided to the District.

Ponderosa and Jeffrey pines are used as bioindicators of air pollution injury because they are very sensitive to ozone. The symptom of ozone injury is called "chlorotic mottle", which consists of small yellow spots on the older needles of affected pines. Monitoring for injury requires having pine foliage in hand for examination. Taller trees must be sampled using telescoping pole pruners that reach up to 30 feet. Trees are sampled in the late summer or fall after foliage has been exposed to ambient air pollution for most of the growing season.

Table 1. FPM Ozone Injury Plots On The Kings River Ranger District And Their Condition As Of 1993.

PLOT NAME	PLOT NO.	ELEV. FEET	T.	R.	SEC.	INJURY CATEGORY	% TREES INJURED
1. Soaproot Saddle	83	4000	10S	25E	29	Moderate	60
2. Dinkey Creek	99	6000	10S	26E	9	Slight	20
3. Cabin Meadow	103	7000	10S	26E	15	Slight	50
4. Blue Canyon	105	4000	11S	25E	12	Moderate	70
5. Weisman Spring	116	6000	12S	27E	10	Severe	90

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Table 2. History of Ozone Rating Scores For Kings River Ranger District Plots

YEAR VISITED	PLOT NUMBER AND OZONE RATING*				
	83	99	103	105	116
1977	3.9	3.5	3.5	2.9	2.8
1978/79	-	3.6	-	1.9	-
1980/81	-	3.2	4.0	1.3	-
1982/83	2.7	3.4	3.6	1.5	-
1985	3.2	3.7	4.0	1.3	2.1
1987	2.3	3.4	3.8	1.5	2.2
1989	2.7	3.5	3.7	1.4	2.5
1991	3.1	3.5	3.7	2.1	2.1
1993	2.5	3.6	3.6	2.1	1.7

* Ozone rating and corresponding injury category

<u>RATING</u>	<u>INJURY CATEGORY</u>
0.0 - 0.9	= Very Severe
1.0 - 1.9	= Severe
2.0 - 2.9	= Moderate
3.0 - 3.9	= Slight
4.0	= No Injury

DISCUSSION/CONCLUSIONS:

Several conclusions can be drawn from the data collected at ozone monitoring plots and from 15 years of observations in the southern Sierra Nevada. The amount of injury and the trends in ozone scores on the Kings River plots are fairly representative of what has happened throughout the Sierra and Sequoia National Forests.

1. Symptoms of injury are common and widespread and have been found on plots at all elevations between 4000 and 8000 feet. The most severe injury, however, has been on plots at 6000 feet or less. Also, injury is greatest in plots closest to the Central Valley and along major river drainages - these are the locations exposed to the highest quantities of ozone.
2. The amount of foliar symptoms due to air pollution increased dramatically in the 2-3 years following the 1976-1978 California drought, but then leveled off and actually began to slowly decrease during the years of protracted drought between 1984 and 1993.
3. Ponderosa and Jeffrey pines reduce their level of photosynthetic activity during drought conditions. This in turn results in less injury from ozone because less is taken up by the drought-stressed pines.

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4. Some pine mortality on FPM trend plots has been attributed to ozone damage. Trees killed primarily by ozone tend to be small intermediate or suppressed understory pines. Of the 50 trees in the five Kings River District plots, two (4%) have died, with severe ozone injury, during the 16 years between 1977 and 1993. In the Sierra Nevada, bark beetles, associated with drought stress, are much more likely to kill pines than ozone.
5. Sensitive pines (about 50% of the population) on the Kings River plots will continue to suffer the effects of ozone as this pollutant moves each year into the mountains from the populated portions of the San Joaquin Valley.

Please contact me if you need additional information or if you have questions about this summary.

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